

**AQUATERRA**  
ENVIRONMENTAL SOLUTIONS, INC.

July 15, 2008

Mr. Ray Pilapil  
Illinois Environmental Protection Agency  
Compliance Section #40  
P.O. Box 19276  
Springfield, Illinois 62794-9276

Re: Initial Compliance Test Report  
Flare Performance Testing  
Cottonwood Hills Recycling and Disposal Facility

Dear Mr. Pilapil:

Aquaterra Environmental Solutions, Inc. (Aquaterra) on behalf of our client, Waste Management, Inc., has enclosed two copies of the *Initial Compliance Test Report, Heating Value, Velocity, and Visible Emissions of a Utility Flare, Cottonwood Hills Recycling and Disposal Facility, Marissa, Illinois* dated May 2008. Please feel free to contact Andy Limmer at (618) 394-9622 with any questions or comments regarding this report.

Sincerely,  
**Aquaterra Environmental Solutions, Inc.**

  
Andy Limmer, P.G.  
Senior Project Manager

 FOR  
Nathan Higgerson  
Project Manager

CC: Ernest Dennison, P.E. - Waste Management of Illinois, Inc.  
Kevin Mattison – IEPA Bureau of Air, Des Plaines  
John Justice – IEPA Bureau of Air, Field Operation Section

**INITIAL COMPLIANCE TEST REPORT  
HEATING VALUE, VELOCITY, AND VISIBLE EMISSIONS  
OF A UTILITY FLARE  
COTTONWOOD HILLS RECYCLING AND DISPOSAL FACILITY  
MARISSA, ILLINOIS**

**Aquaterra Project Number 2484.20  
July 2008**

**AQUA**

***Prepared For:***

**Waste Management of Illinois, Inc.  
601 Madison Avenue  
East St. Louis, Illinois 62201**

**AQUATERRA  
ENVIRONMENTAL SOLUTIONS, INC.**

**WM00259**

**Initial Compliance Test Report  
Heating Value, Velocity, and Visible Emissions  
of a Utility Flare  
Cottonwood Hills Recycling and Disposal Facility  
Marissa, Illinois  
July 2008**

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**Initial Compliance Test Report  
Heating Value, Velocity, and Visible Emissions  
of a Utility Flare  
Cottonwood Hills Recycling and Disposal Facility  
Marissa, Illinois  
July 2008**

**1.0 INTRODUCTION**

Aquaterra Environmental Solutions, Inc. (Aquaterra) was retained by Waste Management of Illinois, Inc., to perform the 2008 initial performance testing of the new utility flare at the Cottonwood Hills Recycling and Disposal Facility (Cottonwood Hills RDF) located in Marissa, Illinois. The initial flare testing was performed in accordance with the requirements of the Illinois Environmental Protection Agency (IEPA), 40 CFR 60.18 and the New Source Performance Standards found in 40 CFR 60, Subpart WWW. Nathan Higgerson of Aquaterra performed the Cottonwood Hills RDF initial flare testing on April 17, 2008 and collected a supplemental sample on May 22, 2008.

**Initial Compliance Test Report**  
**Cottonwood Hills Recycling and Disposal Facility**  
**Marissa, Illinois**  
**July 2008**

## **2.0 PROCESS OVERVIEW**

The Cottonwood Hills RDF landfill gas collection and control system is routed to a landfill gas utility flare. The utility flare is used for the destruction of landfill gas and the control of landfill gas emissions. The flare began operation on February 5, 2008. The flare inlet pipe is 12 inches in diameter and composed of high density polyethylene (SDR-17) piping. The flare exit pipe is 10 inches in diameter. The flare was continually operated on a full-time basis with a flame present at all times during the test period. A diagram of the Cottonwood Hills RDF flare system is provided in Appendix A.

**Initial Compliance Test Report**  
**Cottonwood Hills Recycling and Disposal Facility**  
**Marissa, Illinois**  
**July 2008**

### **3.0 TEST METHODOLOGIES AND RESULTS**

The Cottonwood Hills RDF initial flare testing was performed in accordance with the guidelines of the following USEPA test methods outlined in 40 CFR 60, Appendix A and the IEPA approved Open Flare Test Plan dated January 2008 by Aquaterra.:

- Fuel Heating Value by ASTM Methods D1946 and D3588,
- Method 2D – Determination of Gas Volumetric Flow Rate in Small Pipes or Ducts, and
- Method 22 – Determination of Fugitive Emissions from Material Sources and Smoke Emissions from Flares.
- Method 3C – Determination of Carbon Dioxide, Methane, Nitrogen, and Oxygen from Stationary Sources.

The test was conducted on April 17, 2008 at the new utility flare. The visual test of the new utility flare emissions was conducted during the April 2008 test event. Samples of landfill gas were collected for laboratory analyses during the test event. Copies of the Cottonwood Hills flare testing field logs are presented in Appendix B. Field testing information including sampling times and flare system performance data, including gas and flare temperatures and gas pressure readings, are recorded on the field logs.

Samples CW-1, CW-2, and CW-3 were collected on April 17, 2008 and the flare unit began operation on February 5, 2008. The landfill gas samples were collected during three consecutive sample runs for laboratory analysis. The landfill gas samples were collected under vacuum at the Cottonwood Hills flare inlet using evacuated stainless steel tanks (summa canisters). A calibrated flow control regulator was used to regulate the flow of landfill gas at the approximate flow rate of 100 cc/min into each evacuated summa canister. The landfill gas sample canisters were delivered to TestAmerica Laboratories, Inc. in Santa Ana, California for laboratory analysis. Copies of the landfill gas sample analytical results are presented in Appendix C.

Aquaterra also collected samples to be analyzed to determine the Hydrogen Sulfide content of the landfill gas. The additional samples were collected on May 22, 2008 using a 10 liter and 1 liter tedlar bag. The tedlar bags were allowed to fill for two minutes from the same sampling port as the previously collected samples. The sample containers were sent to TestAmerica for analysis. The test method used by TestAmerica was EPA Method 15/16.

**Initial Compliance Test Report**  
**Cottonwood Hills Recycling and Disposal Facility**  
**Marissa, Illinois**  
**July 2008**

The results yielded a level of 12 parts per million by volume. The 1 liter tedlar bag leaked during shipment to the laboratory.

### **3.1 Visible Emissions**

Visible emissions (opacity) testing of the Cottonwood Hills RDF flare was performed on April 18, 2008, in accordance with USEPA Method 22, *Determination of Fugitive Emissions from Material Sources and Smoke Emissions from Flares*. The visual emissions from the utility flare were continuously monitored for a 2-hour timeframe and documented at 5-minute intervals. A 5-minute rest period occurred after each 20-minute observation period. The Method 22 test results for the Cottonwood Hills RDF flare are summarized on the Method 22 Testing Field Log presented in Appendix B. A summary of the acceptable Cottonwood Hills RDF flare visible emissions testing results is presented as follows.

#### **Cottonwood Hills Flare Visible Emission Summary**

<b>Visible Elapsed Emission Time per 2 hours</b>	<b>Allowable Visible Emission Time per 2 hours</b>
0 seconds	5 minutes

### **3.2 Fuel Heating Value**

A total of three samples of the landfill gas were analyzed for net heating value by ASTM Methods D1946 and D3588. The heating value results for the Cottonwood Hills RDF initial flare test event were calculated in accordance with 40 CFR 60.18(f)(3) and are in compliance with the minimum requirements as described in 40 CFR 60.18(b)(3)(ii). The Cottonwood Hills RDF flare heating value results are presented in Appendix D. A summary of the calculated and minimum allowable heating values for the Cottonwood Hills RDF flare test events are presented below.

**Initial Compliance Test Report**  
**Cottonwood Hills Recycling and Disposal Facility**  
**Marissa, Illinois**  
**July 2008**

**Cottonwood Hills Flare Fuel Heating Value Summary**

Date	Run No.	Calculated Heating Value (MJ/scm)	Minimum Allowable Heating Value (MJ/scm)
4/17/08	CW-1	10.9	7.45
4/17/08	CW-2	10.9	7.45
4/17/08	CW-3	10.9	7.45

**3.3 Cottonwood Hills Flare Flow Rate Determination**

The inlet landfill gas velocity was determined from a pitot tube located in the 10-inch nominal diameter pipe between the blower and the utility flare. The pressure in the pipe was measured with an electronic pressure meter, a Shortridge Instruments, Inc. Airdata Multimeter ADM 860 #M00577. The thermocouple provided a direct reading of the inlet gas temperature. The landfill gas sample mass flowrate was determined using the calculated velocity and results from the landfill gas fuel heating value laboratory analytical results.

The Cottonwood Hills RDF flare exit velocity was determined from the calculated gas mass flow rate and the cross sectional area of the 10-inch diameter flare tip. The maximum permitted exit velocity was determined by the calculations found in 40 CFR 60, 60.18(f)(5). The corresponding gas flow rate calculations are presented in Appendix D. The on-site calculated exit velocities are less than the maximum permitted exit velocities. A summary of the calculated and maximum permitted velocities for the Cottonwood Hills RDF flare test event is presented below.

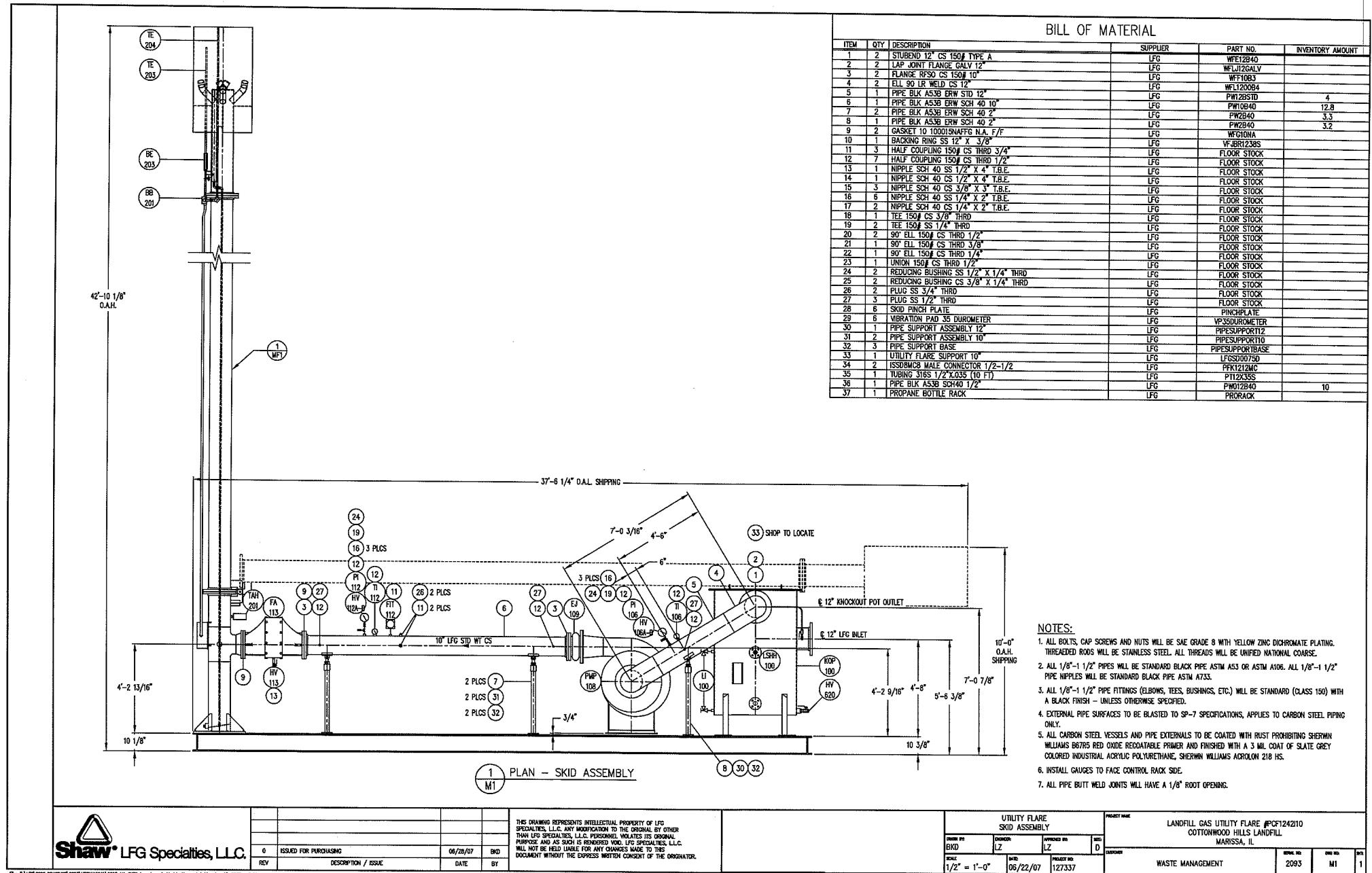
**Cottonwood Flare Exit Velocity Summary**

Date	Run No.	Calculated Exit Velocity (m/s)	Maximum Permitted Velocity (m/s)
4/17/08	CW-1	17.5	17.8
4/17/08	CW-2	17.7	17.8
4/17/08	CW-3	17.2	17.8

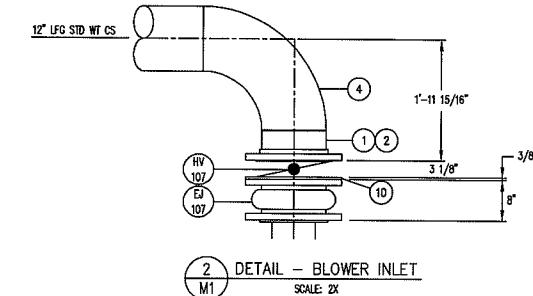
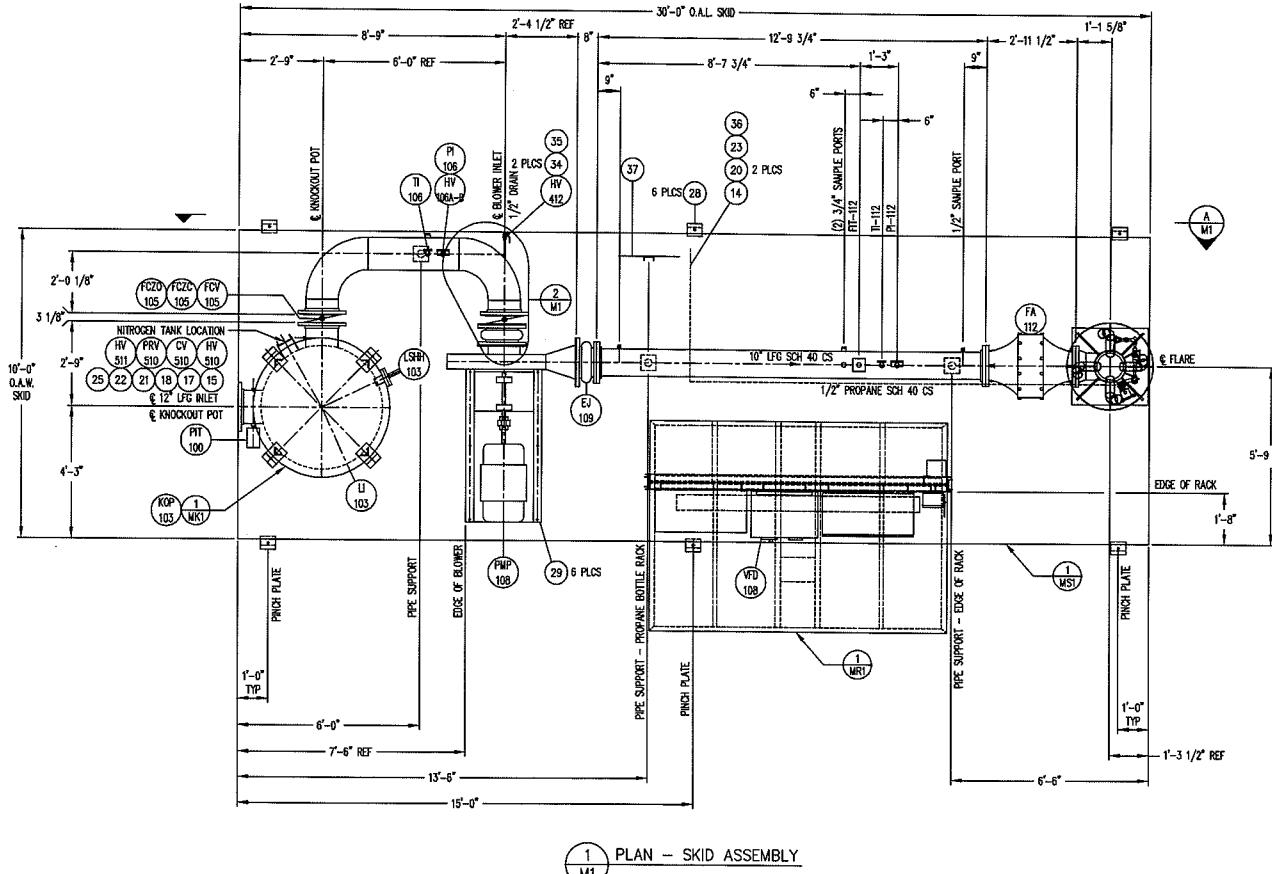
**APPENDIX A  
UTILITY FLARE DIAGRAM**

**AQUATERRA**  
ENVIRONMENTAL SOLUTIONS, INC.

WM00268



SYSTEM TO BE ORIENTED  
WITH THE FLARE CONTROL  
PANEL FACING NORTH



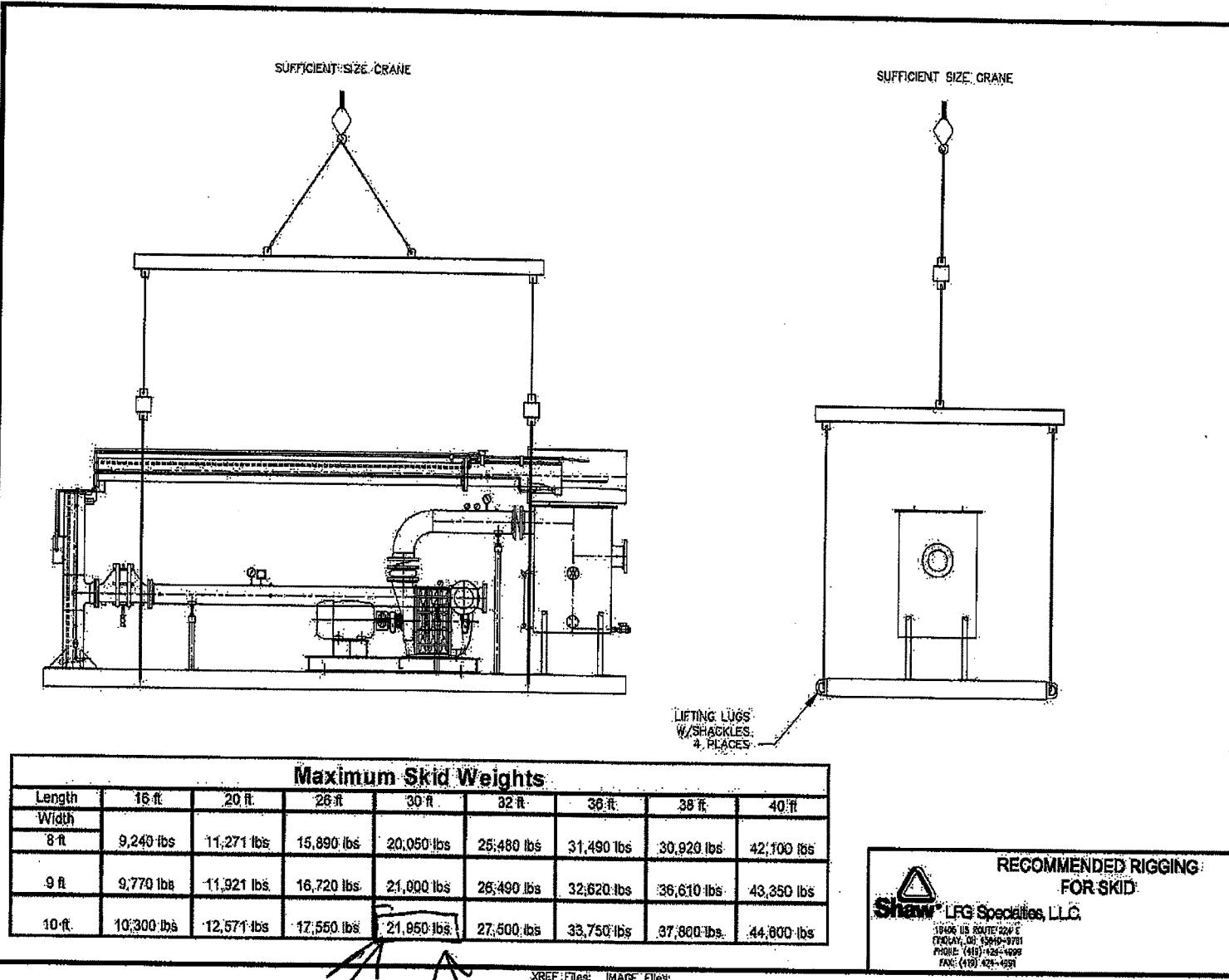
FOR B.O.M. SEE DRAWING 2093-M1-SHT2



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THIS DRAWING REPRESENTS INTELLECTUAL PROPERTY OF LFG SPECIALTIES, LLC. ANY MODIFICATION TO THE ORIGINAL BY OTHER THAN LFG SPECIALTIES, LLC. PERSONNEL, VIOLATES ITS ORIGINAL PROPRIETARY RIGHTS. THIS DRAWING IS THE PROPERTY OF LFG SPECIALTIES, LLC. AND WILL NOT BE HELD LIABLE FOR ANY CHANGES MADE TO THIS DOCUMENT WITHOUT THE EXPRESS WRITTEN CONSENT OF THE ORIGINATOR.

UTILITY FLARE SKID ASSEMBLY				PROJECT NAME
DRAWN BY	DESIGNED BY	APPROVED BY	RECD	LANDFILL GAS UTILITY FLARE #PCF124210 COTTONWOOD HILLS LANDFILL MARISIA, IL
BKD	LZ		D	
SCALE	DATE	PROJECT NO	ISSUED	WASTE MANAGEMENT
1/2" = 1'-0"	06/22/07	127337		2093
			M1	1



XREF: Files: IMAGE.FLDS  
File: W:\LFG\Tire Charges 2004\SKIDDING.dwg Layout: Model User: tom\_seagro Date: 03/20/2004 - 4:22pm

**APPENDIX B  
FIELD LOGS**

**AQUATELLA**  
ENVIRONMENTAL SOLUTIONS, INC.

WM00272

# AQUATELLA ENVIRONMENTAL SOLUTIONS, INC.

## LANDFILL GAS FLARE TESTING LOG

Waste Management, Inc.  
Cottonwood Hills Recycling and Disposal Facility  
Marissa, Illinois

Sampler Nathan Higgerson

Date 4/17/2008  
Sample I.D. CW-1  
Vessel I.D. 93098  
Vessel Vol. 6.0 liter

### Temperature Measurements

Flare Temp.\* 1089 Deg. F  
Gas Temp.\*\* 88 Deg. F

\* Measured with CAT 123-6700 Infrared Thermometer II with Laser Sighting

\*\* Measured with in-line thermometer

### Orifice Plate Measurements

Static Pressure\* 0.8255 Inches Hg  
\* Measured with Shorridge Instruments, Inc. Airdata Multimeter ADM 860 #M00577

### Summa Canister Vacuum Readings

Initial Vacuum -30 Inches Hg  
Final Vacuum -6 Inches Hg

The flow regulator was calibrated at 100 cc/min and the canister was allowed to fill for 45 min.

Start Time 1510  
End Time 1555

# AQUATERRA ENVIRONMENTAL SOLUTIONS, INC.

## LANDFILL GAS FLARE TESTING LOG

Waste Management, Inc.  
Cottonwood Hills Recycling and Disposal Facility  
Marissa, Illinois

Sampler Nathan Higgerson

Date 4/17/2008  
Sample I.D. CW-2  
Vessel I.D. 9151B  
Vessel Vol. 6.0 liter

### Temperature Measurements

Flare Temp.\* 1028 Deg. F  
Gas Temp.\*\* 88 Deg. F

\* Measured with CAT 123-6700 Infrared Thermometer II with Laser Sighting

\*\* Measured with in-line thermometer

### Orifice Plate Measurements

Static Pressure\* 0.8375 Inches Hg

\* Measured with Shorridge Instruments, Inc. Airdata Multimeter ADM 860 #M00577

### Summa Canister Vacuum Readings

Initial Vacuum -30 Inches Hg  
Final Vacuum -6 Inches Hg

The flow regulator was calibrated at 100 cc/min and the canister was allowed to fill for 50 min.

Start Time 1600  
End Time 1650

# AQUATERRA ENVIRONMENTAL SOLUTIONS, INC.

## LANDFILL GAS FLARE TESTING LOG

Waste Management, Inc.  
Cottonwood Hills Recycling and Disposal Facility  
Marissa, Illinois

Sampler Nathan Higgerson

Date 4/17/2008  
Sample I.D. CW-3  
Vessel I.D. A-310  
Vessel Vol. 6.0 liter

### Temperature Measurements

Flare Temp.\* 1122 Deg. F  
Gas Temp.\*\* 86 Deg. F

\* Measured with CAT 123-6700 Infrared Thermometer II with Laser Sighting

\*\* Measured with in-line thermometer

### Pito Tube Measurements

Static Pressure\* 0.7986 Inches Hg

\* Measured with Shortridge Instruments, Inc. Airdata Multimeter ADM 860 #M00577

### Summa Canister Vacuum Readings

Initial Vacuum -30 Inches Hg  
Final Vacuum -6 Inches Hg

The flow regulator was calibrated at 100 cc/min and the canister was allowed to fill for 50 min.

Start Time 1655  
End Time 1745

**APPENDIX C**  
**LABORATORY ANALYTICAL RESULTS**

**AQUATELLA**  
ENVIRONMENTAL SOLUTIONS, INC.

WM00276

# TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

May 16, 2008

LOT NUMBER: **E8D280201**  
PO/CONTRACT: 2484.20

Andy Limmer  
Aquaterra Environmental Sol  
141 Market Place Drive  
Suite 204  
Fairview Heights, IL 62208

Dear Mr. Limmer,

This report contains the analytical results for the three samples received under chain of custody by TestAmerica on April 24, 2008. These samples are associated with your IL31|Cottonwood Hills RDF project.

TestAmerica certifies that the test results provided in this report meet all NELAP requirements for parameters for which accreditation is required or available. Any exceptions to NELAP requirements are noted in the case narrative. The case narrative is an integral part of the report. NELAP Certification Number for the Los Angeles laboratory is E87652.

Any matrix related anomaly is footnoted within the report. Historical control limits for the LCS are used to define the estimate of uncertainty for a method. All applicable quality control procedures met method-specified acceptance criteria except as noted on the following page.

Preliminary results were sent via facsimile on May 6, 2008.

This report shall not be reproduced except in full, without the written approval of the laboratory.

This report contains **000036** pages.



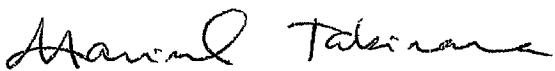
1721 South Grand Avenue Santa Ana, CA 92705 tel 714.258.8610 fax 714.258.0921 www.testamericainc.com

## CASE NARRATIVE

All samples for method 25C have been corrected for nitrogen. STP conditions are used in this calculation. Samples for EPA 25C are analyzed in triplicate and 3C samples are run in duplicate. EPA 3C/25C result summary forms are available.

If you have any questions, please feel free to call me at (714) 258-8610.

Sincerely,



Marisol Tabirara  
Project Manager

cc: Project File



**TestAmerica Los Angeles**

1721 South Grand Ave  
Santa Ana, CA 92705  
Phone 714-258-8610 Fax 714-258-0921

**Canister Samples Chain of Custody Record**

*TestAmerica Laboratories, Inc. assumes no liability with respect to the collection and shipment of these samples.*

**TestAmerica**

THE LEADER IN ENVIRONMENTAL TESTING

Client Contact Information		Project Manager: A. Limmer		E8D280201		1 of 1 COCs														
Company: AQUATERRRA ENV.	Phone: (618-394-9622)	Samples Collected By:																		
Address: 141 Market Place Dr Ste 204	Email: alimmer@aquterra-env.com																			
City/State/Zip Fairview Heights IL 62208	Site Contact:																			
Phone: (618-394-9622)	LAB Contact:																			
FAX: (618-394-9633)																				
Project Name: Cottonwood Hills RDF Flare Sampling	Analysis Turnaround Time																			
Site: Cottonwood Hills RDF	Standard (Specify) <input checked="" type="checkbox"/>																			
PO # 2484.20	Rush (Specify)																			
Sample Identification	Sample Date(s)	Time Start	Time Stop	Canister Vacuum in Field, "Hg (Start)	Canister Vacuum in Field, "Hg (Stop)	Flow Controller ID	Canister ID	TO-45	TO-14A	TO-3	EPA 3C	EPA 25C	ASTM D-1946	Other (Please specify in notes section)	Sample Type	Indoor Air	Ambient Air	Soil Gas	Landfill Gas	Other (Please specify in notes section)
CW - 1	4/17/08	1510	1555	-30	-6	HF041	93098				X X									X
CW - 2	4/17/08	1600	1650	-30	-6	HF041	9151B				X X									X
CW - 3	4/17/08	1655	1745	-30	-6	HF041	A-310				X X									X
Temperature (Fahrenheit)								Other = Heating Value ASTM D3588												
	Interior	Ambient																		
Start		75° F																		
Stop		72° F																		
Pressure (inches of Hg)																				
	Interior	Ambient																		
Start																				
Stop																				
Special Instructions/QC Requirements & Comments:																				
Samples Shipped by: <i>Nathan Higginson</i>	Date/Time: 3/13/08 1600	Samples Received by: <i>Nathan Higginson</i>																		
Samples Relinquished by: <i>Nathan Higginson</i>	Date/Time: 4/18/08 1000	Received by:																		
Relinquished by: <i>Nathan Higginson</i>	Date/Time: 4/24/08 0945	Received by: <i>Nathan Higginson</i>																		
Lab Use Only	Shipper Name:	Opened by:	Condition:																	

## CANISTER FIELD DATA RECORD

CLIENT: WMI / AQUATERRA  
 CANISTER SERIAL #: 93098  
 DATE CLEANED: 3.5.08 B  
 CLIENT SAMPLE #: \_\_\_\_\_  
 SITE LOCATION: \_\_\_\_\_

VFR ID: HF041

Duration of comp.: 45 Hrs. /mins.

Flow setting: 105 - 111 ml/min

Initials: KA

READING	TIME	Vac. (inches Hg) Or PRESS. (psig)	DATE	INITIALS
INITIAL VACUUM CHECK		<u>30</u>	<u>3/13/08</u>	<u>KA</u>
INITIAL FIELD VACUUM				
FINAL FIELD READING				

LABORATORY CANISTER PRESSURIZATION			
INITIAL VACUUM (inches Hg / PSIA (circle unit used))	<u>11.46</u>	<u>4/29/08</u>	<u>61</u>
FINAL PRESSURE (PSIA)	<u>23.34</u>	<u>4/29/08</u>	<u>61</u>

Pressurization Gas: N<sub>2</sub>

COMPOSITE TIME (HOURS)	FLOW RATE RANGE (ml/min)
15 Min.	316 - 333
30 Min.	158 - 166.7
1	79.2 - 83.3
2	39.6 - 41.7
4	19.8 - 20.8
6	13.2 - 13.9
8	9.9 - 10.4
10	7.92 - 8.3
12	6.6 - 6.9
24	3.5 - 4.0

## CANISTER FIELD DATA RECORD

2

CLIENT: WMI / AQUATERPA  
 CANISTER SERIAL #: 9151 B  
 DATE CLEANED: 3.5.08 B  
 CLIENT SAMPLE #: \_\_\_\_\_  
 SITE LOCATION: \_\_\_\_\_

VFR ID: HF041

Duration of comp.: 45 Hrs. /mins.

Flow setting: 105 - 111 ml/min

Initials: (initials)

READING	TIME	Vac. (inches Hg) Or PRESS. (psig)	DATE	INITIALS
INITIAL VACUUM CHECK		30"	3/13/08	KJ
INITIAL FIELD VACUUM				
FINAL FIELD READING				

LABORATORY CANISTER PRESSURIZATION			
INITIAL VACUUM (inches Hg) PSIA (circle unit used))	11.63	4/29/08	-6'
FINAL PRESSURE (PSIA)	23.32	4/29/08	6'

Pressurization Gas: N<sub>2</sub>

COMPOSITE TIME (HOURS)	FLOW RATE RANGE (ml/min)
15 Min.	316 - 333
30 Min.	158 - 166.7
1	79.2 - 83.3
2	39.6 - 41.7
4	19.8 - 20.8
6	13.2 - 13.9
8	9.9 - 10.4
10	7.92 - 8.3
12	6.6 - 6.9
24	3.5 - 4.0

## CANISTER FIELD DATA RECORD

CLIENT: WMI / AQUATERPA

CANISTER SERIAL #: A-310

DATE CLEANED: 3.5.08 B

CLIENT SAMPLE #:

SITE LOCATION:

VFR ID: HF041

Duration of comp.: 45 Hrs. /mins.

Flow setting: 105 - 111 ml/min

Initials: KA

READING	TIME	Vac. (inches Hg) Or PRESS. (psig)	DATE	INITIALS
INITIAL VACUUM CHECK		30"	3/13/08	KA
INITIAL FIELD VACUUM				
FINAL FIELD READING				

## LABORATORY CANISTER PRESSURIZATION

INITIAL VACUUM (inches Hg / PSIA (circle unit used))	11.46...	4/29/08	63"
FINAL PRESSURE (PSIA)	23.72	4/29/08	63"

Pressurization Gas: N2

COMMENTS:

COMPOSITE TIME (HOURS)	FLOW RATE RANGE (ml/min)
15 Min.	316 - 333
30 Min.	158 - 166.7
1	79.2 - 83.3
2	39.6 - 41.7
4	19.8 - 20.8
6	13.2 - 13.9
8	9.9 - 10.4
10	7.92 - 8.3
12	6.6 - 6.9
24	3.5 - 4.0

# Analytical Report

## **ANALYTICAL REPORT**

IL31 | Cottonwood Hills RDF

Lot #: E8D280201

Andy Limmer

Aquaterra Environmental Sol

TESTAMERICA LABORATORIES, INC.

Marisol Tabirara  
Project Manager

May 6, 2008

## EXECUTIVE SUMMARY - Detection Highlights

E8D280201

<u>PARAMETER</u>	<u>RESULT</u>	<u>REPORTING LIMIT</u>	<u>UNITS</u>	<u>ANALYTICAL METHOD</u>
<b>CW-1 04/17/08 15:10 001</b>				
Carbon dioxide	38	0.020	% (v/v)	CFR60 EPA 3C
Methane	53	0.00041	% (v/v)	CFR60 EPA 3C
Oxygen	0.44	0.41	% (v/v)	CFR60 EPA 3C
Nitrogen	8.4	2.0	% (v/v)	CFR60 EPA 3C
Total Non-Methane Hydrocarbons	6700	61	ppm-c	CFR60A EPA 25C
Heat of Combustion	540	0.10	BTU/FT3	ASTM D3588
<b>CW-2 04/17/08 16:00 002</b>				
Carbon dioxide	38	0.020	% (v/v)	CFR60 EPA 3C
Methane	53	0.00040	% (v/v)	CFR60 EPA 3C
Oxygen	0.40	0.40	% (v/v)	CFR60 EPA 3C
Nitrogen	8.2	2.0	% (v/v)	CFR60 EPA 3C
Total Non-Methane Hydrocarbons	7800	60	ppm-c	CFR60A EPA 25C
Heat of Combustion	540	0.10	BTU/FT3	ASTM D3588
<b>CW-3 04/17/08 16:55 003</b>				
Carbon dioxide	38	0.021	% (v/v)	CFR60 EPA 3C
Methane	53	0.00041	% (v/v)	CFR60 EPA 3C
Oxygen	0.56	0.41	% (v/v)	CFR60 EPA 3C
Nitrogen	8.6	2.1	% (v/v)	CFR60 EPA 3C
Total Non-Methane Hydrocarbons	8200	62	ppm-c	CFR60A EPA 25C
Heat of Combustion	540	0.10	BTU/FT3	ASTM D3588

## **ANALYTICAL METHODS SUMMARY**

E8D280201

<u>PARAMETER</u>	<u>ANALYTICAL METHOD</u>
Fixed Gases	
Heat of Combustion	& Relative Density
Non-Condensable	CFR60 EPA 3C ASTM D3588 CFR60A EPA 25C

### **References:**

- ASTM Annual Book Of ASTM Standards.
- CFR60 "Test Methods," 40 CFR, Part 60, July 1, 1997
- CFR60A "Test Methods", 40 CFR, Part 60, Appendix A, July 1, 1993.

## SAMPLE SUMMARY

E8D280201

WO #	SAMPLE#	CLIENT SAMPLE ID	SAMPLED DATE	SAMP TIME
KL6LM	001	CW-1	04/17/08	15:10
KL6LN	002	CW-2	04/17/08	16:00
KL6LP	003	CW-3	04/17/08	16:55

**NOTE(S) :**

- The analytical results of the samples listed above are presented on the following pages.
- All calculations are performed before rounding to avoid round-off errors in calculated results.
- Results noted as "ND" were not detected at or above the stated limit.
- This report must not be reproduced, except in full, without the written approval of the laboratory.
- Results for the following parameters are never reported on a dry weight basis: color, corrosivity, density, flashpoint, ignitability, layers, odor, paint filter test, pH, porosity pressure, reactivity, redox potential, specific gravity, spot tests, solids, solubility, temperature, viscosity, and weight.

Aquaterra Environmental Solutions Inc

Client Sample ID: CW-1

GC Volatiles

Lot-Sample #....: E8D280201-001 Work Order #....: KL6LM1AD Matrix.....: AE  
Date Sampled....: 04/17/08 15:10 Date Received...: 04/24/08  
Prep Date.....: 04/30/08 Analysis Date...: 04/30/08  
Prep Batch #....: 8127280 Analysis Time...: 08:28  
Dilution Factor: 1  
Analyst ID.....: 402431 Instrument ID...: GC7  
Method.....: ASTM D3588

<u>PARAMETER</u>	<u>RESULT</u>	<u>REPORTING LIMIT</u>	<u>UNITS</u>
Heat of Combustion	540	0.10	BTU/FT3

Aquaterra Environmental Solutions Inc

Client Sample ID: CW-1

GC Volatiles

Lot-Sample #....: E8D280201-001 Work Order #....: KL6LM1AC Matrix.....: AE  
Date Sampled....: 04/17/08 15:10 Date Received...: 04/24/08  
Prep Date.....: 04/29/08 Analysis Date...: 04/29/08  
Prep Batch #....: 8120546 Analysis Time...: 12:01  
Dilution Factor: 2.04  
Analyst ID.....: 999995 Instrument ID...: GC8  
Method.....: CFR60A EPA 25C

PARAMETER	RESULT	REPORTING LIMIT	UNITS
Total Non-Methane Hydrocarbons as Methane	6700	61	ppm-c

Aquaterra Environmental Solutions Inc

Client Sample ID: CW-1

GC Volatiles

Lot-Sample #....: E8D280201-001 Work Order #....: KL6LM1AA Matrix.....: AE  
Date Sampled....: 04/17/08 15:10 Date Received...: 04/24/08  
Prep Date.....: 04/29/08 Analysis Date...: 04/29/08  
Prep Batch #....: 8120545 Analysis Time...: 12:01  
Dilution Factor: 2.04  
Analyst ID.....: 999995 Instrument ID...: GC8  
Method.....: CFR60 EPA 3C

<u>PARAMETER</u>	<u>RESULT</u>	<u>REPORTING</u>	<u>LIMIT</u>	<u>UNITS</u>
Carbon dioxide	38		0.020	% (v/v)
Carbon monoxide	ND		0.0020	% (v/v)
Methane	53		0.00041	% (v/v)
Oxygen	0.44		0.41	% (v/v)
Nitrogen	8.4		2.0	% (v/v)

Aquaterra Environmental Solutions Inc

Client Sample ID: CW-2

GC Volatiles

Lot-Sample #....: E8D280201-002 Work Order #....: KL6LN1AD Matrix.....: AE  
Date Sampled...: 04/17/08 16:00 Date Received..: 04/24/08  
Prep Date.....: 04/30/08 Analysis Date...: 04/30/08  
Prep Batch #....: 8127280 Analysis Time...: 08:55  
Dilution Factor: 1  
Analyst ID.....: 402431 Instrument ID...: GC7  
Method.....: ASTM D3588

PARAMETER	REPORTING		
	RESULT	LIMIT	UNITS
Heat of Combustion	540	0.10	BTU/FT3

Aquaterra Environmental Solutions Inc

Client Sample ID: CW-2

GC Volatiles

Lot-Sample #....: E8D280201-002 Work Order #....: KL6LN1AC Matrix.....: AE  
Date Sampled...: 04/17/08 16:00 Date Received..: 04/24/08  
Prep Date.....: 04/29/08 Analysis Date...: 04/29/08  
Prep Batch #....: 8120546 Analysis Time..: 13:19  
Dilution Factor: 2.01  
Analyst ID.....: 999995 Instrument ID...: GC8  
Method.....: CFR60A EPA 25C

PARAMETER	RESULT	REPORTING LIMIT	UNITS
Total Non-Methane Hydrocarbons as Methane	7800	60	ppm-c

Aquaterra Environmental Solutions Inc

Client Sample ID: CW-2

GC Volatiles

Lot-Sample #....: E8D280201-002 Work Order #....: KL6LN1AA Matrix.....: AE  
Date Sampled....: 04/17/08 16:00 Date Received...: 04/24/08  
Prep Date.....: 04/29/08 Analysis Date...: 04/29/08  
Prep Batch #....: 8120545 Analysis Time...: 13:19  
Dilution Factor: 2.01  
Analyst ID.....: 999995 Instrument ID...: GC8  
Method.....: CFR60 EPA 3C

PARAMETER	RESULT	REPORTING	
		LIMIT	UNITS
Carbon dioxide	38	0.020	% (v/v)
Carbon monoxide	ND	0.0020	% (v/v)
Methane	53	0.00040	% (v/v)
Oxygen	0.40	0.40	% (v/v)
Nitrogen	8.2	2.0	% (v/v)

Aquaterra Environmental Solutions Inc

Client Sample ID: CW-3

GC Volatiles

Lot-Sample #....: E8D280201-003 Work Order #....: KL6LP1AD Matrix.....: AE  
Date Sampled...: 04/17/08 16:55 Date Received...: 04/24/08  
Prep Date.....: 04/30/08 Analysis Date...: 04/30/08  
Prep Batch #....: 8127280 Analysis Time...: 09:23  
Dilution Factor: 1  
Analyst ID.....: 402431 Instrument ID...: GC7  
Method.....: ASTM D3588

PARAMETER	RESULT	REPORTING LIMIT	UNITS
Heat of Combustion	540	0.10	BTU/FT3

Aquaterra Environmental Solutions Inc

Client Sample ID: CW-3

GC Volatiles

Lot-Sample #....: E8D280201-003 Work Order #...: KL6LP1AC Matrix.....: AE  
Date Sampled...: 04/17/08 16:55 Date Received..: 04/24/08  
Prep Date.....: 04/29/08 Analysis Date..: 04/29/08  
Prep Batch #....: 8120546 Analysis Time..: 14:38  
Dilution Factor: 2.07  
Analyst ID.....: 999995 Instrument ID...: GC8  
Method.....: CFR60A EPA 25C

PARAMETER	RESULT	REPORTING LIMIT	UNITS
Total Non-Methane Hydrocarbons as Methane	8200	62	ppm-c

Aquaterra Environmental Solutions Inc

Client Sample ID: CW-3

GC Volatiles

Lot-Sample #....: E8D280201-003 Work Order #....: KL6LP1AA Matrix.....: AE  
Date Sampled...: 04/17/08 16:55 Date Received...: 04/24/08  
Prep Date.....: 04/29/08 Analysis Date...: 04/29/08  
Prep Batch #....: 8120545 Analysis Time...: 14:38  
Dilution Factor: 2.07  
Analyst ID.....: 999995 Instrument ID...: GC8  
Method.....: CFR60 EPA 3C

PARAMETER	REPORTING		
	RESULT	LIMIT	UNITS
Carbon dioxide	38	0.021	% (v/v)
Carbon monoxide	ND	0.0021	% (v/v)
Methane	53	0.00041	% (v/v)
Oxygen	0.56	0.41	% (v/v)
Nitrogen	8.6	2.1	% (v/v)

# QA/QC

## QC DATA ASSOCIATION SUMMARY

E8D280201

### Sample Preparation and Analysis Control Numbers

<u>SAMPLE#</u>	<u>MATRIX</u>	<u>ANALYTICAL METHOD</u>	<u>LEACH BATCH #</u>	<u>PREP BATCH #</u>	<u>MS RUN#</u>
001	AE	CFR60 EPA 3C		8120545	
	AE	CFR60A EPA 25C		8120546	
	AE	ASTM D3588		8127280	
002	AE	CFR60 EPA 3C		8120545	
	AE	CFR60A EPA 25C		8120546	
	AE	ASTM D3588		8127280	
003	AE	CFR60 EPA 3C		8120545	
	AE	CFR60A EPA 25C		8120546	
	AE	ASTM D3588		8127280	

METHOD BLANK REPORT

GC Volatiles

Client Lot #...: E8D280201      Work Order #...: KMA541AA      Matrix.....: AIR  
MB Lot-Sample #: M8D290000-546  
Analysis Date...: 04/29/08      Prep Date.....: 04/29/08      Analysis Time..: 11:34  
Dilution Factor: 1      Prep Batch #: 8120546      Instrument ID..: GC8  
Analyst ID.....: 999995

PARAMETER	REPORTING			METHOD
	RESULT	LIMIT	UNITS	
Total Non-Methane Hydroca	ND	30	ppm-c	CFR60A EPA 25C

NOTE(S) :

Calculations are performed before rounding to avoid round-off errors in calculated results.

METHOD BLANK REPORT

GC Volatiles

Client Lot #....: E8D280201      Work Order #....: KMA5X1AA      Matrix.....: AIR  
MB Lot-Sample #: M8D290000-545  
Analysis Date...: 04/29/08      Prep Date.....: 04/29/08      Analysis Time...: 11:34  
Dilution Factor: 1      Prep Batch #: 8120545      Instrument ID..: GC8  
Analyst ID.....: 999995

PARAMETER	RESULT	REPORTING		METHOD
		LIMIT	UNITS	
Carbon dioxide	ND	0.010	% (v/v)	CFR60 EPA 3C
Carbon monoxide	ND	0.0010	% (v/v)	CFR60 EPA 3C
Methane	ND	0.00020	% (v/v)	CFR60 EPA 3C
Oxygen	ND	0.20	% (v/v)	CFR60 EPA 3C
Nitrogen	ND	1.0	% (v/v)	CFR60 EPA 3C

NOTE(S) :

Calculations are performed before rounding to avoid round-off errors in calculated results.

LABORATORY CONTROL SAMPLE EVALUATION REPORT

GC Volatiles

Client Lot #....: E8D280201      Work Order #....: KMA541AC-LCS      Matrix.....: AIR  
LCS Lot-Sample#: M8D290000-546      KMA541AD-LCSD  
Prep Date.....: 04/29/08      Analysis Date...: 04/29/08  
Prep Batch #....: 8120546      Analysis Time...: 10:37  
Dilution Factor: 1      Instrument ID...: GC8  
Analyst ID.....: 999995

PARAMETER	PERCENT	RECOVERY	RPD	LIMITS	METHOD
	RECOVERY	LIMITS	RPD	LIMITS	METHOD
Total Non-Methane Hydrocar	90	(80 - 120)			CFR60A EPA 25C
	88	(80 - 120)	2.5	(0-20)	CFR60A EPA 25C

NOTE(S) :

Calculations are performed before rounding to avoid round-off errors in calculated results.

Bold print denotes control parameters

## LABORATORY CONTROL SAMPLE DATA REPORT

## GC Volatiles

Client Lot #....: E8D280201      Work Order #....: KMA541AC-LCS      Matrix.....: AIR  
 LCS Lot-Sample#: M8D290000-546         KMA541AD-LCSD  
 Prep Date.....: 04/29/08      Analysis Date...: 04/29/08  
 Prep Batch #:....: 8120546      Analysis Time...: 10:37  
 Dilution Factor: 1      Instrument ID...: GC8  
 Analyst ID.....: 999995

PARAMETER	SPIKE	MEASURED		PERCENT	RPD	METHOD
	AMOUNT	AMOUNT	UNITS	RECOVERY		
Total Non-Methane Hydrocar	60.0	54.2	ppm-c	90		CFR60A EPA 25C
	60.0	52.8	ppm-c	88	2.5	CFR60A EPA 25C

NOTE(S) :

Calculations are performed before rounding to avoid round-off errors in calculated results.

Bold print denotes control parameters

## LABORATORY CONTROL SAMPLE EVALUATION REPORT

## GC Volatiles

Client Lot #....: E8D280201      Work Order #....: KMA5X1AC-LCS      Matrix.....: AIR  
**LCS Lot-Sample#:** M8D290000-545      **KMA5X1AD-LCSD**  
 Prep Date.....: 04/29/08      Analysis Date...: 04/29/08  
 Prep Batch #....: 8120545      Analysis Time...: 07:56  
 Dilution Factor: 1      Instrument ID...: GC8  
 Analyst ID.....: 999995

PARAMETER	PERCENT	RECOVERY	RPD	LIMITS	METHOD
	RECOVERY	LIMITS			
Carbon dioxide	99	(75 - 125)			CFR60 EPA 3C
	100	(75 - 125)	0.38	(0-20)	CFR60 EPA 3C
Methane	103	(75 - 135)			CFR60 EPA 3C
	103	(75 - 135)	0.30	(0-20)	CFR60 EPA 3C
Carbon monoxide	104	(70 - 130)			CFR60 EPA 3C
	104	(70 - 130)	0.18	(0-30)	CFR60 EPA 3C
Nitrogen	105	(70 - 130)			CFR60 EPA 3C
	105	(70 - 130)	0.53	(0-30)	CFR60 EPA 3C
Oxygen	103	(70 - 130)			CFR60 EPA 3C
	103	(70 - 130)	0.44	(0-30)	CFR60 EPA 3C
Ethane	101	(70 - 130)			CFR60 EPA 3C
	101	(70 - 130)	0.030	(0-30)	CFR60 EPA 3C
Ethene	101	(70 - 130)			CFR60 EPA 3C
	101	(70 - 130)	0.070	(0-30)	CFR60 EPA 3C

**NOTE(S) :**

Calculations are performed before rounding to avoid round-off errors in calculated results.

Bold print denotes control parameters

**LABORATORY CONTROL SAMPLE DATA REPORT**

GC Volatiles

PARAMETER	SPIKE	MEASURED		PERCENT		METHOD
	AMOUNT	AMOUNT	UNITS	RECOVERY	RPD	
Carbon dioxide	0.500	0.496	% (v/v)	99		CFR60 EPA 3C
	0.500	0.498	% (v/v)	100	0.38	CFR60 EPA 3C
Methane	0.0250	0.0257	% (v/v)	103		CFR60 EPA 3C
	0.0250	0.0257	% (v/v)	103	0.30	CFR60 EPA 3C
Carbon monoxide	0.0250	0.0260	% (v/v)	104		CFR60 EPA 3C
	0.0250	0.0259	% (v/v)	104	0.18	CFR60 EPA 3C
Nitrogen	10.0	10.5	% (v/v)	105		CFR60 EPA 3C
	10.0	10.5	% (v/v)	105	0.53	CFR60 EPA 3C
Oxygen	2.50	2.58	% (v/v)	103		CFR60 EPA 3C
	2.50	2.57	% (v/v)	103	0.44	CFR60 EPA 3C
Ethane	0.0250	0.0252	% (v/v)	101		CFR60 EPA 3C
	0.0250	0.0252	% (v/v)	101	0.030	CFR60 EPA 3C
Ethene	0.0250	0.0252	% (v/v)	101		CFR60 EPA 3C
	0.0250	0.0251	% (v/v)	101	0.070	CFR60 EPA 3C

**NOTE (S) :**

Calculations are performed before rounding to avoid round-off errors in calculated results.

**Bold print denotes control parameters**

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**EPA 25C TRIPPLICATE RESULTS**

Date Analyzed / QC Batch: 09/29/08/ 8120546

# GC8 EPA 25C TNMOC SUMMARY REPORT

---

LAB SAMPLE ID#: E8D280201-1

CLIENT NAME: AQUATELLA  
CLIENT SAMPLE ID: CW-1

		Date	Time	Dilution Factor
25C RAW DATA FILES Run 1:	I0329-1	04/29/08	12:01	2.0366
Run 2:	I0329-2	04/29/08	12:27	2.0366
Run 3:	I0329-3	04/29/08	12:53	2.0366

EPA 25C DF: 2.0366 Date: 4/29/2008

COMPOUND	Run 1	Run 2	Run 3	Average	RSD=15%	BASE RL's	
	Results	Results	Results	Results	%RSD	RL	ppm
TNMOC	6683.77	6683.62	6680.42	6682.0943	0.028	61.1	30

NITROGEN	Results	Results	Results	Results	RSD=15%
	%v/v	%v/v	%v/v	%v/v	%RSD
	8.3895	8.3535	8.3804	8.3849	0.224
NO N2 CORRECTION	112.0154	112.0154	112.0154	112.0154	

COMMENTS: CANISTER PRE-PRESSURIZED WITH HELIUM  
FINAL PRESSURE: 23.34  
INITIAL PRESSURE: 21.46

TNMOC as CH4	RAW AMOUNT	ADJUSTED TNMOC RESULTS		NMOC	ETHENE	ETHANE
		RESULTS	%RSD			
RUN1	5762.866	6683.77		6682.866	0.000	0.000
RUN2	5765.795	6683.62		6685.795	0.000	0.000
RUN3	5760.752	6680.42		6680.752	0.000	0.000

NOTE: TNMOC RESULTS ADJUSTED PER NITROGEN VALUES AND STP

LEVEL 1

5/4/2008

LEVEL 2

ATLA

# GC8 EPA 25C TNMOC SUMMARY REPORT

---

LAB SAMPLE ID#: ESD250201-2

CLIENT NAME: AQUATELLA  
CLIENT SAMPLE ID: CW-2

	Date	Time	Dilution Factor
25C RAW DATA FILES Run 1: 0330-1	04/29/08	13:19	2.0052
Run 2: 0330-2	04/29/08	13:45	2.0052
Run 3: 0330-3	04/29/08	14:12	2.0052

EPA 25C DF: 2.0052 Date: 4/29/2008

COMPOUND	Run 1	Run 2	Run 3	Average	RSD=15%	BASE RL's	
	Results	Results	Results	Results	%RSD	RL	ppm
TNMOC	7866.77	7839.56	7798.18	7832.4753	0.441	60.2	30

NITROGEN	Results	Results	Results	Results	RSD=15%
	%v/v	%v/v	%v/v	%v/v	%RSD
	8.2140	8.1950	7.9823	8.0981	1.585
NO N2 CORRECTION	108.77300	105.7110	106.49902		

COMMENTS: CANISTER PRE-PRESSURIZED WITH HELIUM  
FINAL PRESSURE 23.92  
INITIAL PRESSURE 13.63

TNMOC as CH4	RAW AMOUNT	ADJUSTED TNMOC RESULTS
RUN1	6800.392	7866.77
RUN2	6778.670	7839.56
RUN3	6764.037	7798.18

	NMOC	ETHENE	ETHANE
	6800.392	0.000	0.000
	6778.670	0.000	0.000
	6764.037	0.000	0.000

NOTE: TNMOC RESULTS ADJUSTED PER NITROGEN VALUES AND STP

LEVEL 1

5/4/30/08

LEVEL 2

1568

# GC8 EPA 25C TNMOC SUMMARY REPORT

LAB SAMPLE ID#: E8D280201-3

CLIENT NAME: AQUATELLA  
CLIENT SAMPLE ID: CW-3

	Date	Time	Dilution Factor
25C RAW DATA FILES Run 1: 03331-1	04/29/08	14:39	2.0698
Run 2: 03331-2	04/29/08	15:04	2.0698
Run 3: 03331-3	04/29/08	15:20	2.0698

EPA 25C DF: 2.0698 Date: 4/29/2008

COMPOUND	Run 1	Run 2	Run 3	Average	RSD=15%	BASE RL's	
	Results	Results	Results	Results	%RSD	RL	ppm
TNMOC	8168.66	8168.38	8140.31	8154.4849	0.200	62.1	30

NITROGEN	Results	Results	Results	Results	RSD=15%
	%v/v	%v/v	%v/v	%v/v	%RSD
	8.6327	8.6366	8.5576	8.5951	0.517
NO N2 CORRECTION	115.6135	115.6174	115.5694		

COMMENTS: CANISTER PRE-PRESSURIZED WITH HELIUM  
FINAL PRESSURE: 23.72  
INITIAL PRESSURE: 13.46

TNMOC as CH4	RAW AMOUNT	ADJUSTED TNMOC RESULTS
RUN1	7017.952	8168.66
RUN2	7017.309	8168.38
RUN3	7001.351	8140.31

NMOC	ETHENE	ETHANE
7017.952	0.006	0.000
7017.309	0.001	0.000
7001.351	0.000	0.000

NOTE: TNMOC RESULTS ADJUSTED PER NITROGEN VALUES AND STP

LEVEL 1

5/4/30/08

LEVEL 2

MF68

EPA250(TNMOC) PROTECT022001

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## **EPA 3C DUPLICATE RESULTS**

Date Analyzed / QC Batch: 04/29/08/8120545

**TESTAMERICA LOS ANGELES ANALYTICAL SERVICES**  
**EPA 3C SAMPLE RESULTS SUMMARY CALCULATION**

Lot ID: E8D280201-1                              Final(F) Lab Pressure: 28.34  
 Data File(s): d329 -1                              Sample(S) Receipt Pressure: 11.46  
 Date Acquired: 4/29/2008 12:01 ; 12:27              Prepressurized? (He,NO): NO  
 Dilution Factor: 2.04                              Lab Pressurized? (N2,NO): N2  
 Pre-pressure: 0                                      Serial Dilution: 1

Analyte	RUN1 PPM(v/v)	RUN2 PPM(v/v)	RPD (10%)	AVERAGE PPM(v/v)	AVERAGE %v/v	RL %v/v	BASE RL %v/v
Carbon Dioxide:	378152.81	378118.18	0.01	378135.49	37.813549	0.02037	0.01
Oxygen/Argon:	4540	4322	4.92	4431	0.443073	0.40733	0.2
Nitrogen:	83895	83534	0.43	83715	8.371457	2.03665	1
Methane:	527292.55	527667.30	0.07	527479.93	52.747993	0.00041	0.0002
Ethene:	0.00	0.00	#DIV/0!	0.00	0.000000	0.00204	0.001
Ethane:	0.00	0.00	#DIV/0!	0.00	0.000000	0.00102	0.0005
Carbon Monoxide:	13.62	13.36	1.72	13.74	0.001374	0.00204	0.001
%Total:	99.389	99.366					
	RUN1 PPM(v/v)	RUN2 PPM(v/v)		RUN1 %(v/v)	RUN2 %(v/v)		
Nitrogen File Result:	1120544.03	1120183.54		112.0544031	112.0183545		

LEVEL 2 1110.8

EPA3C E8D280201-1

LEVEL 2 or 5.61

**TESTAMERICA LOS ANGELES ANALYTICAL SERVICES**  
**EPA 3C SAMPLE RESULTS SUMMARY CALCULATION**

Lot ID: E8D280201-2                              Final(F) Lab Pressure: 23.32  
 Data File(s): d330 -1                              Sample(S) Receipt Pressure: 11.63  
 Date Acquired: 4/29/2008 13:19 ; 13:45              Prepressurized? (He,NO): NO  
 Dilution Factor: 2.01                              Lab Pressurized? (N2,NO): N2  
 Pre-pressure: 0                                      Serial Dilution: 1

Analyte	RUN1 PPM(v/v)	RUN2 PPM(v/v)	RPD (10%)	AVERAGE PPM(v/v)	AVERAGE %v/v	RL %v/v	BASE RL %v/v
Carbon Dioxide:	379885.41	379630.75	0.07	379758.08	37.975808	0.02005	0.01
Oxygen/Argon:	3972	3980	0.20	3976	0.397623	0.40103	0.2
Nitrogen:	82140	81958	0.22	82049	8.204921	2.00516	1
Methane:	529315.88	529628.68	0.06	529472.28	52.947228	0.00040	0.0002
Ethene:	0.00	0.00	#DIV/0!	0.00	0.000000	0.00201	0.001
Ethane:	0.00	0.00	#DIV/0!	0.00	0.000000	0.00100	0.0005
Carbon Monoxide:	13.24	13.15	0.66	13.20	0.001320	0.00201	0.001
%Total:	99.533	99.521					
	RUN1 PPM(v/v)	RUN2 PPM(v/v)		RUN1 %(v/v)	RUN2 %(v/v)		
Nitrogen File Result:	108.29951	108.711704		108.7299512	108.7117042		

LEVEL 1 5/5/08

EPA3C E8D280201-2

LEVEL 2 5/5/08

**TESTAMERICA LOS ANGELES ANALYTICAL SERVICES**  
**EPA 3C SAMPLE RESULTS SUMMARY CALCULATION**

Lot ID: E8D280201-3  
 Data File(s): d331 -1  
 Date Acquired: 4/29/2008 14:38 ; 15:04  
 Dilution Factor: 2.07

Final(F) Lab Pressure: 23.72  
 Sample(S) Receipt Pressure: 31.46  
 Prepressurized? (He,NO): NO  
 Lab Pressurized? (N2,NO): N2  
 Pre-pressure: 0  
 Serial Dilution:

Analyte	RUN1 PPM(v/v)	RUN2 PPM(v/v)	RPD (10%)	AVERAGE PPM(v/v)	AVERAGE %v/v	RL %v/v	BASE RL %v/v
Carbon Dioxide:	377131.44	377129.37	0.00	377130.41	37.713041	0.02070	0.01
Oxygen/Argon:	5562	5601	0.70	5581	0.558124	0.41396	0.2
Nitrogen:	86327	86366	0.05	86346	8.634638	2.06981	1
Methane:	525487.00	525306.99	0.03	525396.97	52.539697	0.00041	0.0002
Ethene:	0.00	0.00	#DIV/0!	0.00	0.000000	0.00207	0.001
Ethane:	0.00	0.00	#DIV/0!	0.00	0.000000	0.00103	0.0005
Carbon Monoxide:	12.91	13.25	2.59	13.08	0.001308	0.00207	0.001
%Total:	99.452	99.442					
	RUN1 PPM(v/v)	RUN2 PPM(v/v)		RUN1 %(v/v)	RUN2 %(v/v)		
Nitrogen File Result:	1156134.74	1156174.07		115.613474	115.6174066		

LEVEL 1 b's 5108

EPA3C E8D280201-3

LEVEL 2 a's 5-6.1

# TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

1721 South Grand Avenue Santa Ana, CA 92705 \* 714-258-8610 \* Fax 714-258-0921

May 30, 2008

## LABORATORY REPORT

Client:

Aquaterra Environmental Solution Fairview Heights  
141 Market Place Drive Suite 204  
Fairview Heights, IL 62208  
Attn: Andy Limmer

Work Order: LRE0202  
Project Name: IL31 Cottonwood Hills RDF  
Project Number: [none]  
Date Received: 05/23/08

*The results listed within this Laboratory Report pertain only to the samples tested in the laboratory. The analyses contained in this report were performed in accordance with the applicable certifications as noted. This Laboratory Report is confidential and is intended for the sole use of TestAmerica and its client. This report shall not be reproduced, except in full, without written permission from TestAmerica.*

*TestAmerica Laboratories, Inc. certifies that the analytical results contained herein apply only to the specific sample(s) analyzed.*

*The Chain of Custody, 1 page, is included and is an integral part of this report. This entire report was reviewed and approved for release.*

If you have any questions relating to this analytical report, please contact your Laboratory Project Manager at 714-258-8610.

Analyses included in this report were performed by the laboratory shown at the top of this report unless otherwise indicated.

Approved By:

NELAP Certification # E87652

---

DRAFT REPORT  
DATA SUBJECT TO CHANGE

WM00313

# TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

1721 South Grand Avenue Santa Ana, CA 92705 \* 714-258-8610 \* Fax 714-258-0921

Aquaterra Environmental Solution Fairview Heights  
141 Market Place Drive Suite 204  
Fairview Heights, IL 62208  
Andy Limmer

Work Order: LRE0202

Received: 05/23/08 09:45

Reported: 05/30/08 14:53

Project: IL31 Cottonwood Hills RDF

Project Number: [none]

<u>SAMPLE IDENTIFICATION</u>	<u>LAB NUMBER</u>	<u>COLLECTION</u>	<u>MATRIX</u>	<u>CONTAINER TYPE</u>
DRAFT: CW-1A	LRE0202-01	05/22/08 16:00	Air	Tedlar Bag 10L
DRAFT: CW-1A DUP	LRE0202-03	05/22/08 16:00	Air	Tedlar Bag 10L



THE LEADER IN ENVIRONMENTAL TESTING

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Aquaterra Environmental Solution Fairview Heights  
141 Market Place Drive Suite 204  
Fairview Heights, IL 62208  
Andy Limmer

Work Order: LRE0202  
Project: IL31 Cottonwood Hills RDF  
Project Number: [none]

Received: 05/23/08 09:45  
Reported: 05/30/08 14:53

## CORRECTIVE ACTION REPORT

Department: Sample Control

Date: 05/23/2008

Method:

Matrix:

QC Batch:

### Identification and Definition of Problem:

Sample #02 was not analyzed.

### Determination of the Cause of the Problem:

The Tedlar bag that contained sample #02 was leaking when received at the laboratory. The sample completely leaked before analysis could be performed.

### Corrective Action Taken:

Client was notified of the nonconformance on May 22, 2008.

Reviewed By: \_\_\_\_\_  
Maria Friedman

Date: 05/28/2008 04:27 PM

WM00315

# TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

1721 South Grand Avenue Santa Ana, CA 92705 \* 714-258-8610 \* Fax 714-258-0921

Aquaterra Environmental Solution Fairview Heights  
141 Market Place Drive Suite 204  
Fairview Heights, IL 62208  
Andy Limmer

Work Order: LRE0202

Received: 05/23/08 09:45

Reported: 05/30/08 14:53

Project: IL31 Cottonwood Hills RDF  
Project Number: [none]

## ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
---------	--------	-----------------	-------	----	----------	---------------	------------	---------	----------

Sample ID: LRE0202-01 (DRAFT: CW-1A - Air)

Sampled: 05/22/08 16:00

DRAFT: EPA 15/16 - Sulfur Compounds

Hydrogen sulfide	12		ppmv	0.50	10	05/23/08 12:44	GC7	TD	8E23004
------------------	----	--	------	------	----	----------------	-----	----	---------

WM00316

# TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

1721 South Grand Avenue Santa Ana, CA 92705 \* 714-258-8610 \* Fax 714-258-0921

Aquaterra Environmental Solution Fairview Heights  
141 Market Place Drive Suite 204  
Fairview Heights, IL 62208  
Andy Limmer

Work Order: LRE0202

Received: 05/23/08 09:45  
Reported: 05/30/08 14:53

Project: IL31 Cottonwood Hills RDF  
Project Number: [none]

## ANALYTICAL REPORT

Analyte	Result	Data Qualifiers	Units	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
---------	--------	-----------------	-------	----	----------	---------------	------------	---------	----------

Sample ID: LRE0202-03 (DRAFT: CW-1A DUP - Air)

Sampled: 05/22/08 16:00

DRAFT: EPA 15/16 - Sulfur Compounds

Hydrogen sulfide	12		ppmv	0.50	10	05/23/08 12:57	GC7	TD	8E23004
------------------	----	--	------	------	----	----------------	-----	----	---------

WM00317

# TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

1721 South Grand Avenue Santa Ana, CA 92705 \* 714-258-8610 \* Fax 714-258-0921

Aquaterra Environmental Solution Fairview Heights  
141 Market Place Drive Suite 204  
Fairview Heights, IL 62208  
Andy Limmer

Work Order: LRE0202

Received: 05/23/08 09:45  
Reported: 05/30/08 14:53

Project: IL31 Cottonwood Hills RDF  
Project Number: [none]

## PROJECT QUALITY CONTROL DATA

Blank

Analyte	Result	Data Qualifier	Units	RL	Dilution	Date Analyzed	Instrument	Analyst	QC Batch
<b>Sample ID: 8E23004-BLK1 (Blank - Air)</b>									
<b>DRAFT: EPA 15/16 - Sulfur Compounds</b>									
Hydrogen sulfide	ND		ppmv	0.050	1.00	05/23/08 12:18	GC7	TD	8E23004

## PROJECT QUALITY CONTROL DATA

LCS

Analyte	Result	Data Qualifiers	Units	RL	Dilution	Spike Conc	% Rec	Target Range	Instrument	Date Analyzed	QC Batch
<b>Sample ID: 8E23004-BS1 (LCS - Air)</b>											
<b>DRAFT: EPA 15/16 - Sulfur Compounds</b>											
Hydrogen sulfide	0.728		ppmv	0.050	1.00	0.980	74%	60 - 130	GC7	05/23/08 11:51	8E23004

## PROJECT QUALITY CONTROL DATA

LCS Dup

Analyte	Result	Data Qualifiers	Units	RL	Dilution	Spike Conc	% Rec	Target Range	RPD Limit	Date Analyzed	QC Batch
<b>Sample ID: 8E23004-BSD1 (LCS Dup - Air)</b>											
<b>DRAFT: EPA 15/16 - Sulfur Compounds</b>											
Hydrogen sulfide	0.718		ppmv	0.050	1.00	0.980	73%	60 - 130	1	25	05/23/08 12:04

WM00318

AQUATERRA

141 Market Place Drive, Suite 204  
Fairview Heights, IL 62208  
Phone: (618) 394-9622  
Fax: (618) 394-9633

## **CHAIN OF CUSTODY / LABORATORY ANALYSIS REQUEST**

PAGE 1 OF 1

**SPECIAL INSTRUCTIONS**

LRE0202

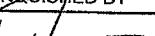
PROJECT NAME Cottonwood Hills Initial Flare Sampling	PROJECT NUMBER 2484-20
SAMPLER (SIGNATURE) 	RESULTS ATTENTION TO: A. Limmer Fax: (618) 394-9633

**REMARKS**

Pull 2 samples from this bag

SHIPPING VIA:	
FedEx	<b>FED EX</b>
SHIPPING NO.:	
PRIORITY: <b>Overnight</b>	

	LABORATORY PRIORITY	
24-Hour	<input checked="" type="checkbox"/> STANDARD	OTHER
PROVIDE VERBAL PRELIMINARY RESULTS		
		<input type="checkbox"/> FAX

RELINQUISHED BY	RECEIVED BY	RELINQUISHED BY	RECEIVED BY
	Steve Gonzales		
SIGNATURE Nathan Higginson Tony Mueller	SIGNATURE 	SIGNATURE	SIGNATURE
PRINTED NAME Aquaterra	PRINTED NAME TA-LA	PRINTED NAME	PRINTED NAME
FIRM 5/22/08 1700	FIRM 5/23/08 0945	FIRM	FIRM
DATE/TIME	DATE/TIME	DATE/TIME	DATE/TIME

**APPENDIX D  
CALCULATIONS**

**Net Heating Value  
Exit Velocity  
Maximum Permitted Exit Velocity**

**AQUATELLA  
ENVIRONMENTAL SOLUTIONS, INC.**

WM00320

**NET HEATING VALUE**

**AQUATELLA**  
ENVIRONMENTAL SOLUTIONS, INC.

WM00321

**AQUATELLA ENVIRONMENTAL SOLUTIONS, INC.**  
**LANDFILL GAS FLARE TESTING LOG**  
**NET HEATING VALUE CALCULATIONS**

Waste Management, Inc.  
Cottonwood Hills Recycling and Disposal Facility  
Marissa, Illinois

Input

Sample No. **CW-1**

Percent Methane: 53 Percent  
Laboratory Measured Fuel Gas Heating Value: 540 Btu/scf at 60 deg. F and 760 mm Hg

Net Heating Value calculated using the following equation:

$$H(T) = K C H$$

where:

H (T): Net Heating Value in (MJ/scm) at 25 deg. C, 760 mm Hg

K:  $1.740 \times 10^{-7}$  (1/ppm)(g mole/scm)(MJ/kcal)

where (g mole/scm) is at 20 deg. C

C: concentration of component on wet basis in ppm

H: Laboratory measured heat of combustion  
in (kcal/g mole) at 25 deg. C, 760 mm Hg

Convert Heat of Combustion from Btu/scf to kcal/g mole

A) Btu/scf to Btu/lb-mole

$$540 \times (460+60) \times 10.732 / 14.696 = 205,058.9 \text{ Btu/lb-mole} \quad (60 \text{ deg. F})$$

B) Btu/lb-mole to kcal/g-mole

$$205,058.9 \times 0.252122 / 453.5924 = 114.0 \text{ kcal/g-mole} \quad (60 \text{ deg. F})$$

C) kcal/g-mole (60 deg F) to kcal/g-mole (25 deg C)

$$114.0 \times (77+460) / (60+460) = 117.7 \text{ kcal/g-mole} \quad (25 \text{ deg. C})$$

Now calculate Net Heating Value

$$H(T) = K C H$$

$$H(T) = 1.740 \times 10^{-7} (1/\text{ppm})(\text{g mole/scm})(\text{MJ/kcal}) \times 540,000 \text{ ppm} \times 117.7 \text{ kcal/g-mole}$$

$$H(T) = 10.9 \text{ MJ/scm}$$

**AQUATELLA ENVIRONMENTAL SOLUTIONS, INC.**  
**LANDFILL GAS FLARE TESTING LOG**  
**NET HEATING VALUE CALCULATIONS**

**Waste Management, Inc.**  
**Cottonwood Hills Recycling and Disposal Facility**  
**Marissa, Illinois**

Input

Sample No. **CW-2**

Percent Methane:

53

Percent

Laboratory Measured Fuel Gas Heating Value:

540

Btu/scf at 60 deg. F and 760 mm Hg

Net Heating Value calculated using the following equation:

$$H(T) = K C H$$

where:

H (T): Net Heating Value in (MJ/scm) at 25 deg. C, 760 mm Hg

K:  $1.740 \times 10^{-7}$  (1/ppm)(g mole/scm)(MJ/kcal)

where (g mole/scm) is at 20 deg. C

C: concentration of component on wet basis in ppm

H: Laboratory measured heat of combustion  
in (kcal/g mole) at 25 deg. C, 760 mm Hg

Convert Heat of Combustion from Btu/scf to kcal/g mole

A) Btu/scf to Btu/lb-mole

$$540 \times (460+60) \times 10.732 / 14.696 = 205,058.9 \text{ Btu/lb-mole} \quad (60 \text{ deg. F})$$

B) Btu/lb-mole to kcal/g-mole

$$205,058.9 \times 0.252122 / 453.5924 = 114.0 \text{ kcal/g-mole} \quad (60 \text{ deg. F})$$

C) kcal/g-mole (60 deg F) to kcal/g-mole (25 deg C)

$$114.0 \times (77+460) / (60+460) = 117.7 \text{ kcal/g-mole} \quad (25 \text{ deg. C})$$

Now calculate Net Heating Value

$$H(T) = K C H$$

$$H(T) = 1.740 \times 10^{-7} (1/\text{ppm})(\text{g mole/scm})(\text{MJ/kcal}) \times 540,000 \text{ ppm} \times 117.7 \text{ kcal/g-mole}$$

$$H(T) = 10.9 \text{ MJ/scm}$$

**AQUATERRA ENVIRONMENTAL SOLUTIONS, INC.**  
**LANDFILL GAS FLARE TESTING LOG**  
**NET HEATING VALUE CALCULATIONS**

**Waste Management, Inc.**  
**Cottonwood Hills Recycling and Disposal Facility**  
**Marissa, Illinois**

Input

Sample No. **CW-3**

Percent Methane:

**53**

Percent

Laboratory Measured Fuel Gas Heating Value:

**540**

Btu/scf at 60 deg. F and 760 mm Hg

Net Heating Value calculated using the following equation:

$$H(T) = K C H$$

where:

H (T): Net Heating Value in (MJ/scm) at 25 deg. C, 760 mm Hg

K:  $1.740 \times 10^{-7}$  (1/ppm)(g mole/scm)(MJ/kcal)

where (g mole/scm) is at 20 deg. C

C: concentration of component on wet basis in ppm

H: Laboratory measured heat of combustion

in (kcal/g mole) at 25 deg. C, 760 mm Hg

Convert Heat of Combustion from Btu/scf to kcal/g mole

A) Btu/scf to Btu/lb-mole

$$540 \times (460+60) \times 10.732 / 14.696 = \quad 205,058.9 \text{ Btu/lb-mole} \quad (60 \text{ deg. F})$$

B) Btu/lb-mole to kcal/g-mole

$$205,058.9 \times 0.252122 / 453.5924 = \quad 114.0 \text{ kcal/g-mole} \quad (60 \text{ deg. F})$$

C) kcal/g-mole (60 deg F) to kcal/g-mole (25 deg C)

$$114.0 \times (77+460) / (60+460) = \quad 117.7 \text{ kcal/g-mole} \quad (25 \text{ deg. C})$$

Now calculate Net Heating Value

$$H(T) = K C H$$

$$H(T) = 1.740 \times 10^{-7} (1/\text{ppm})(\text{g mole/scm})(\text{MJ/kcal}) \times 540,000 \text{ ppm} \times 117.7 \text{ kcal/g-mole}$$

$$H(T) = \quad 10.9 \text{ MJ/scm}$$

**EXIT VELOCITY**

**AQUATELLA**  
ENVIRONMENTAL SOLUTIONS, INC.

WM00325

**AQUATERRA ENVIRONMENTAL SOLUTIONS, INC.**  
**LANDFILL GAS FLARE TESTING LOG**  
**EXIT VELOCITY DETERMINATION**

Waste Management, Inc.  
 Cottonwood Hills Recycling and Disposal Facility  
 Marissa, Illinois

Input

Sample No. **CW-1**

Date **4/17/2008**

Landfill Gas (Dry)

Constituent	Percentage	Molecular Wt. (lb-Mole)
Methane	53.0%	16
Carbon Dioxide	38.0%	44
Oxygen	0.4%	32
Carbon Monoxide	0.0%	28
Nitrogen*	8.4%	28
Total	100.0%	
Percent Water**	3%	18

Barometric Pressure	29.96	in Hg
Pressure	0.826	in Hg
Gas Temperature	88	deg. F
Inlet Diameter	12	in
Flare Tip Diameter	10	in

\* Adjusted if necessary to sum constituents to 100%

\*\* estimated

Dry Molecular Weight (lb/lb-mole)

$$\text{MW} = (44 \times 0.38) + (32 \times 0.44) + (28 \times 0.0) + (16 \times 0.53)$$

$$\text{MW} = 34.10 \quad \text{lb/lb-mole}$$

Molecular Weight, at Stack Condition (lb/lb-mole)

$$\text{MW} = (34.10 \times (1 - 0.03)) + (18 \times 0.03)$$

$$\text{MW} = 33.61 \quad \text{lb/lb-mole}$$

Absolute Flue Gas Pressure, Inches of Mercury

$$P_s = 29.96 + 0.826 / 13.6 P_{Br} + P_g / 13.6$$

$$30.02 \text{ Inches of Mercury}$$

Dry Density at STP (68 deg F, 29.92 in Hg), lb/cf

$$\text{DD}_{\text{stp}} = (0.1137 \times 0.38) + (0.0827 \times 0.44) + (0.0724 \times 0.0) + (0.0485 \times 0.53)$$

$$\text{DD}_{\text{stp}} = 0.0881 \quad \text{lb/cf}$$

Wet Density at STP (68 deg F, 29.92 in Hg), lb/cf

$$\text{WD}_{\text{stp}} = 0.0881 \times ((1 - 0.03) + (0.0465 \times 0.03))$$

$$\text{WD}_{\text{stp}} = 0.0856 \quad \text{lb/cf}$$

**AQUATERRA ENVIRONMENTAL SOLUTIONS, INC.**  
**LANDFILL GAS FLARE TESTING LOG**  
**EXIT VELOCITY DETERMINATION (CONTINUED)**

Sample No. CW-1

Average Stack Gas Velocity (ft/sec)

$$V_s = 85.49 \times 1.0 \times \text{SQRT} ((460+88) \times 0.826 / (29.75 \times 33.61))$$
$$V_s = 57.50 \quad \text{ft/sec}$$

Dry Volumetric Flue Gas Flow Rate at Standard Conditions, dscfm

$$Q_{actual} = (60 \times 1.0 \times (68 + 460) \times 29.96 \times 57.5 \times 0.8) / (88 + 460) \times 29.92$$
$$Q_{actual} = 2662.75$$

Stack Gas Flowrate (ACFM)

$$Q_{actual} = 60 \times 57.5 \times 0.8$$
$$Q_{actual} = 2708 \quad \text{ACFM}$$

Average Stack Exit Velocity (ft/sec)

$$V_{exit} = 2708 / (.785 / 60)$$
$$V_{exit} = 57.5 \quad \text{ft/sec}$$

or

$$V_{exit} = 17.5 \quad \text{m/sec}$$

**AQUATERRA ENVIRONMENTAL SOLUTIONS, INC.**  
**LANDFILL GAS FLARE TESTING LOG**  
**EXIT VELOCITY DETERMINATION**

Waste Management, Inc.  
 Cottonwood Hills Recycling and Disposal Facility  
 Marissa, Illinois

Input

Sample No. **CW-2**

Date **4/17/2008**

Landfill Gas (Dry)

Constituent	Percentage	Molecular Wt. (lb-Mole)
Methane	53.0%	16
Carbon Dioxide	38.0%	44
Oxygen	0.4%	32
Carbon Monoxide	0.0%	28
Nitrogen*	8.2%	28
Total	100.0%	
Percent Water**	3%	18

Barometric Pressure	29.96	in Hg
Pressure	0.8375	in Hg
Gas Temperature	88	deg. F
Inlet Diameter	12	in
Flare Tip Diameter	10	in

\* Adjusted if necessary to sum constituents to 100%

\*\* estimated

Dry Molecular Weight (lb/lb-mole)

$$\begin{aligned} MW &= (44 \times 0.39) + (32 \times 0.4) + (28 \times 0.0) + (16 \times 0.53) \\ MW &= 34.10 \quad \text{lb/lb-mole} \end{aligned}$$

Molecular Weight, at Stack Condition (lb/lb-mole)

$$\begin{aligned} MW &= (34.10 \times (1 - 0.03)) + (18 \times 0.03) \\ MW &= 33.61 \quad \text{lb/lb-mole} \end{aligned}$$

Absolute Flue Gas Pressure, Inches of Mercury

$$\begin{aligned} P_s &= 29.96 + 0.838 / 13.6 P_{Br} + P_g / 13.6 \\ &= 30.02 \quad \text{Inches of Mercury} \end{aligned}$$

Dry Density at STP (68 deg F, 29.92 in Hg), lb/cf

$$\begin{aligned} DD_{stp} &= (0.1137 \times 0.38) + (0.0827 \times 0.4) + (0.0724 \times 0.0) + (0.0485 \times 0.53) \\ DD_{stp} &= 0.0881 \quad \text{lb/cf} \end{aligned}$$

Wet Density at STP (68 deg F, 29.92 in Hg), lb/cf

$$\begin{aligned} WD_{stp} &= 0.0881 \times ((1 - 0.03) + (0.0465 \times 0.03)) \\ WD_{stp} &= 0.0856 \quad \text{lb/cf} \end{aligned}$$

**AQUATELLA ENVIRONMENTAL SOLUTIONS, INC.**  
**LANDFILL GAS FLARE TESTING LOG**  
**EXIT VELOCITY DETERMINATION (CONTINUED)**

Sample No. CW-2

Average Stack Gas Velocity (ft/sec)

$$V_s = 85.49 \times 1.0 \times \text{SQRT} ((460+88) \times 0.838 / (29.75 \times 33.61))$$
$$V_s = 57.92 \quad \text{ft/sec}$$

Dry Volumetric Flue Gas Flow Rate at Standard Conditions, dscfm

$$Q_{actual} = (60 \times 1.0 \times (68 + 460) \times 0.838 \times 57.92 \times 0.8) / ((88 + 460) \times 29.92)$$
$$Q_{actual} = 2682.10$$

Stack Gas Flowrate (ACFM)

$$Q_{actual} = 60 \times 57.92 \times 0.8$$
$$Q_{actual} = 2728 \quad \text{ACFM}$$

Average Stack Exit Velocity (ft/sec)

$$V_{exit} = 2728 / (.785 / 60)$$
$$V_{exit} = 57.9 \quad \text{ft/sec}$$

or

$$V_{exit} = 17.7 \quad \text{m/sec}$$

**AQUATELLA ENVIRONMENTAL SOLUTIONS, INC.**  
**LANDFILL GAS FLARE TESTING LOG**  
**EXIT VELOCITY DETERMINATION**

Waste Management, Inc.  
 Cottonwood Hills Recycling and Disposal Facility  
 Marissa, Illinois

Input

Sample No. CW-3

Date 4/17/2008

Landfill Gas (Dry)

Constituent	Percentage	Molecular Wt. (lb-Mole)
Methane	53.0%	16
Carbon Dioxide	38.0%	44
Oxygen	0.6%	32
Carbon Monoxide	0.0%	28
Nitrogen*	8.6%	28
Total	100.0%	
Percent Water**	3%	18

Barometric Pressure	29.96	in Hg
Pressure	0.7986	in Hg
Gas Temperature	86	deg. F
Inlet Diameter	12	in
Flare Tip Diameter	10	in

\* Adjusted if necessary to sum constituents to 100%

\*\* estimated

Dry Molecular Weight (lb/lb-mole)

$$\text{MW} = (44 \times 0.38) + (32 \times 0.6) + (28 \times 0.0) + (16 \times 0.53)$$

$$\text{MW} = 34.10 \quad \text{lb/lb-mole}$$

Molecular Weight, at Stack Condition (lb/lb-mole)

$$\text{MW} = (34.10 + 0.03) + (18 \times 0.03)$$

$$\text{MW} = 33.62 \quad \text{lb/lb-mole}$$

Absolute Flue Gas Pressure, Inches of Mercury

$$P_s = 29.96 + 0.799 / 13.6 P_{Br} + P_g / 13.6$$

$$30.02 \text{ Inches of Mercury}$$

Dry Density at STP (68 deg F, 29.92 in Hg), lb/cf

$$DD_{stp} = (0.1137 \times 0.38) + (0.0827 \times 0.6) + (0.0724 \times 0.0) + (0.0485 \times 0.53)$$

$$DD_{stp} = 0.0882 \quad \text{lb/cf}$$

Wet Density at STP (68 deg F, 29.92 in Hg), lb/cf

$$WD_{stp} = 0.0882 \times ((1 - 0.03) + (0.0465 \times 0.03))$$

$$WD_{stp} = 0.0856 \quad \text{lb/cf}$$

**AQUATERRA ENVIRONMENTAL SOLUTIONS, INC.**  
**LANDFILL GAS FLARE TESTING LOG**  
**EXIT VELOCITY DETERMINATION (CONTINUED)**

Sample No. CW-3

Average Stack Gas Velocity (ft/sec)

$$V_s = 85.49 \times 1.0 \times \text{SQRT} ((460+86) \times 0.799 / (29.75 \times 33.62))$$
$$V_s = 56.45 \quad \text{ft/sec}$$

Dry Volumetric Flue Gas Flow Rate at Standard Conditions, dscfm

$$Q_{\text{actual}} = (60 \times 1.0 \times (68 + 460) \times 29.96 \times 56.45 \times 0.8) / ((86 + 460) \times 29.92)$$
$$Q_{\text{actual}} = 2623.62$$

Stack Gas Flowrate (ACFM)

$$Q_{\text{actual}} = 60 \times 56.45 \times 0.8$$
$$Q_{\text{actual}} = 2659 \quad \text{ACFM}$$

Average Stack Exit Velocity (ft/sec)

$$V_{\text{exit}} = 2659 / (.785 / 60)$$
$$V_{\text{exit}} = 56.4 \quad \text{ft/sec}$$

or

$$V_{\text{exit}} = 17.2 \quad \text{m/sec}$$

**MAXIMUM PERMITTED EXIT VELOCITY**

**AQUATERRA**  
ENVIRONMENTAL SOLUTIONS, INC.

WM00332

**AQUATELLA ENVIRONMENTAL SOLUTIONS, INC.**  
**LANDFILL GAS FLARE TESTING LOG**  
**MAXIMUM PERMITTED EXIT VELOCITY CALCULATIONS**

**Waste Management, Inc.**  
**Cottonwood Hills Recycling and Disposal Facility**  
**Marissa, Illinois**

Maximum permitted exit velocity calculated using the following equation:

$$\text{Log} (10) (V_{(\max)}) = (H(T) + 28.8)/31.7$$

where:

$V_{(\max)}$ : Maximum permitted exit velocity, m/sec

28.8: Constant

31.7: Constant

H (T): Net Heating Value in (MJ/scm) at 25 deg. C, 760 mm Hg

Sample No. **CW-1** 4/17/2008  
Net Heating Value Heating Value, H(T): 10.9 MJ/scm at 25 deg. C and 760 mm Hg

$$\text{Log} (10) (V_{(\max)}) = (H(T) + 28.8)/31.7$$

$$\text{Log} (10) (V_{(\max)}) = (8.7 + 28.8)/31.7$$

$$\text{Log} (10) (V_{(\max)}) = 1.3$$

$$V_{(\max)} = 17.8 \text{ m/sec}$$

$$V_{(\max)} = 58.5 \text{ ft/sec}$$

**AQUATERRA ENVIRONMENTAL SOLUTIONS, INC.**  
**LANDFILL GAS FLARE TESTING LOG**  
**MAXIMUM PERMITTED EXIT VELOCITY CALCULATIONS**

**Waste Management, Inc.**  
**Cottonwood Hills Recycling and Disposal Facility**  
**Marissa, Illinois**

Maximum permitted exit velocity calculated using the following equation:

$$\text{Log} (10) (V_{(\max)}) = (H(T) + 28.8)/31.7$$

where:

$V_{(\max)}$ : Maximum permitted exit velocity, m/sec

28.8: Constant

31.7: Constant

$H(T)$ : Net Heating Value in (MJ/scm) at 25 deg. C, 760 mm Hg

Sample No. **CW-2** 4/17/2008  
Net Heating Value Heating Value,  $H(T)$ : 10.9 MJ/scm at 25 deg. C and 760 mm Hg

$$\text{Log} (10) (V_{(\max)}) = (H(T) + 28.8)/31.7$$

$$\text{Log} (10) (V_{(\max)}) = (10.1 + 28.8)/31.7$$

$$\text{Log} (10) (V_{(\max)}) = 1.3$$

$$V_{(\max)} = 17.8 \text{ m/sec}$$

$$V_{(\max)} = 58.5 \text{ ft/sec}$$

**AQUATERRA ENVIRONMENTAL SOLUTIONS, INC.**  
**LANDFILL GAS FLARE TESTING LOG**  
**MAXIMUM PERMITTED EXIT VELOCITY CALCULATIONS**

**Waste Management, Inc.**  
**Cottonwood Hills Recycling and Disposal Facility**  
**Marissa, Illinois**

Maximum permitted exit velocity calculated using the following equation:

$$\text{Log} (10) (V_{(\max)}) = (H(T) + 28.8)/31.7$$

where:

$V_{(\max)}$ : Maximum permitted exit velocity, m/sec

28.8: Constant

31.7: Constant

$H(T)$ : Net Heating Value in (MJ/scm) at 25 deg. C, 760 mm Hg

Sample No. **CW-3** 4/17/2008  
Net Heating Value Heating Value,  $H(T)$ : 10.9 MJ/scm at 25 deg. C and 760 mm Hg

$$\text{Log} (10) (V_{(\max)}) = (H(T) + 28.8)/31.7$$

$$\text{Log} (10) (V_{(\max)}) = (10.1 + 28.8)/31.7$$

$$\text{Log} (10) (V_{(\max)}) = 1.3$$

$$V_{(\max)} = 17.8 \text{ m/sec}$$

$$V_{(\max)} = 58.5 \text{ ft/sec}$$